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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
A61F 2/30, 2/42	A1	WO 91/07931
		(43) International Publication Date: 13 June 1991 (13.06.91)

(21) International Application Number: PCT/SE90/00791

(22) International Filing Date: 29 November 1990 (29.11.90)

(30) Priority data:
8904036-4 29 November 1989 (29.11.89) SE

(71) Applicant *(for all designated States except US):* AB VOLVO [SE/SE]; S-405 08 Göteborg (SE).

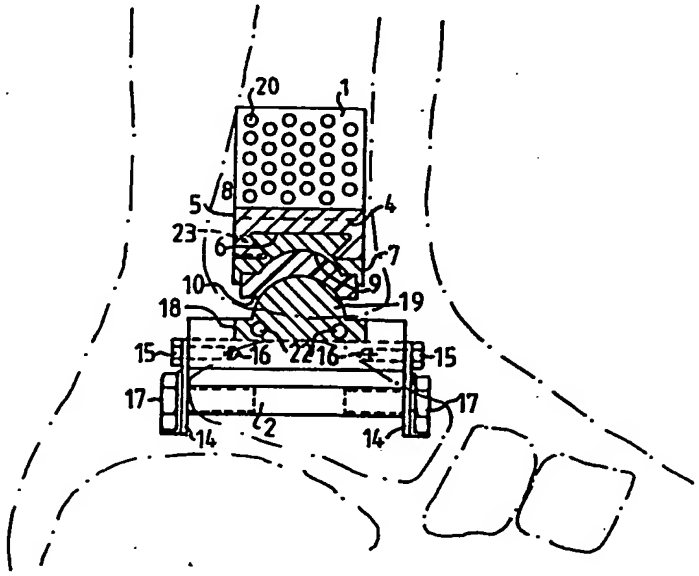
(72) Inventor; and
(75) Inventor/Applicant *(for US only) :* PERSSON, Bengt [SE/SE]; Hjälmvägen 4, S-293 00 Olofström (SE).

(74) Agents: KIERKEGAARD, Lars-Olov et al.; H. Albihns Patentbyrå AB, Box 3137, S-103 62 Stockholm (SE).

(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: ARTIFICIAL JOINT, ESPECIALLY FOR ANKLE JOINTS



(57) Abstract

Ankle prosthesis with titanium components, comprising a ball (19) and a socket (10), joined to anchoring means (1, 2) designed to be surgically implanted in the tibia and in the talus. Via intermediate connecting elements (5, 12) with dovetail grooves (6, 13) arranged perpendicular to each other, lateral adjustment is made possible between the ball and the socket.

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Artificial joint, especially for ankle joints

The present invention relates to a joint prosthesis, comprising a ball and a socket, surgically implantable anchoring means for the ball and the socket, and connecting elements by means of which the ball and the socket can be fixed to their respective anchoring means.

Since it was found that titanium is a biocompatible material, to which human bone tissue adheres after implantation in a bone, ankle prostheses, for example, of titanium have been developed. In a known ankle prosthesis of the type described by way of introduction, anchoring means in the form of titanium plates are used, which, in a first operation, are inserted and screwed securely to the tibia and talus. When the anchoring means after a certain period of time have become integrated with the bone, a second operation is performed in which the ends of the bones are cut off, whereafter the ball and the socket are screwed securely to the anchoring means which are integrated with the bones. Since it is impossible to determine ahead of time the exact position of the anchoring means after it has become integrated with the bone, the surgeon must, at the second operation, either have access to an assortment of different joint components to be certain to find a ball and a socket which will be correctly aligned with each other in view of the positions of the anchoring means, or he must be able during the operation to work on the components of the joint prosthesis in order to achieve a proper fit. This is time consuming and often involves having to accept minor deviations from an ideal alignment.

The purpose of the present invention is to provide a joint prosthesis of the type described by way of introduction, which eliminates the need for working up the components or having a variety of different prosthesis components during the second operation. At the same time, it is intended to

provide a quite exact fit between the socket and the ball.

This is achieved according to the invention in a joint prosthesis of the type described by way of introduction by virtue of the fact that the connecting elements comprise means permitting relative lateral displacement of the ball and of the socket relative to the associated connected element, means for locking the ball and the socket into the respective connecting element after adjustment of the ball and the socket in relation to each other, and means arranged to permit vertical adjustment of the distance between at least one of the anchoring means and associated connecting element.

Complete relative adjustment capability is provided quite simply by providing dovetail grooves running perpendicular to each other and integral with the respective element and by providing the ball and the socket with guide means adapted to these grooves. This provides adjustability along the x- and y-axes, while adjustment along the z-axes can be achieved by adjusting the height or thickness of components in one or both of the connecting elements.

The invention will be described in more detail with reference to an example shown in the accompanying drawing, where
Figure 1 shows a partially sectioned side view of an ankle prosthesis according to the invention, and
Figure 2 shows a front view of the ankle prosthesis in Figure 1.

The ankle prosthesis according to the invention comprises upper and lower anchoring means in the form of a plate 1 and a pair of externally and internally threaded sleeves 2. The plate 1 is provided at its lower end with a bead 3 of circular cross-section, which is disposed in a circular groove 4 in a connecting element in the form of a bridge 5, having a dovetail groove 6 extending perpendicular to the circular groove 4. In the dovetail groove 6, there is

received a slide body 8 having the same profile as the groove 6 and integral with a plate 7. The plate 7 has a depression 9, in which the ankle joint socket 10 is fixed, e.g. by adhesive. The arrangement described makes the socket 10 displaceable laterally relative to the anchoring plate 1. The connection via the bead 3 and the groove 4 makes possible a minor angular adjustment of the bridge 5 relative to the plate 1.

A connecting element in the form of a second bridge 12 with a dovetail groove 13 is joined to the sleeves 2 by means of four links or legs 14. The links 14 are screwed securely to the bridge 12 and the sleeves 2 with the aid of upper screws 15 which are screwed into the threaded bores 16 in the bridge, and lower screws 17 which are screwed into the sleeves 2. A slide body 18 on a hemispherical body 19 serving as a joint ball is received in the groove 13 and permits displacement of the ball in the longitudinal direction of the sleeves 2. The slide bodies 8 and 18 are lockable in their respective grooves 6 and 13 by means of stop screws, e.g. socket-head screws 21, 22, which are screwed into threaded through-bores 23 and 24, respectively, to the respective dovetail groove 6 and 13, respectively.

The ankle prosthesis described is implanted in two operations. In the first operation, the plate 1 is implanted into the tibia and the sleeves 2 are implanted in the talus. The plate 1 is provided with evenly spaced holes 20 over its entire surface, and the surface is also grooved. The holes and the grooves promote maximum bone integration. The sleeves 2 are preferably also provided with holes or perforations (not shown).

When the plate 1 and the sleeves 2 have become integrated with the bone, which takes approximately four months, X-rays can determine the exact position of the components

and determine the length and the angular positioning of the links 14 in order to obtain the correct vertical distance between the ball 19 and the socket 10. During the second operation, the lower bridge 12 is fixed to the talus with the aid of the screws 15 and 17 and the links 14. The bridge 12 is provided on its underside with grooves or teeth 25 for integration with the bone. If the sleeves 2 are perforated, the lower screws 17 will also eventually become integrated with the bone.

The tibia is now shortened so that the cylindrical end surface 3 is exposed and it is slid into the cylindrical groove 4 in the bridge 5. This connection permits compensation for minor angular errors when implanting the plate. The bridge 5 has grooves or teeth 26 on its upper surface for integration with the bone. After mounting the bridges 5, 12, the respective slide bodies 8 and 18 for the ball and socket, respectively, are slipped into their dovetail grooves and are adjusted laterally relative to each other and locked with the associated screws 21, 22. If required, in addition to the vertical adjustment possibility provided by the links, additional vertical adjustment can be achieved by varying the thickness of the upper bridge 5 and/or the slide body 8.

The above invention has been described in an embodiment particularly intended for an ankle joint. Suitable modification of the anchoring means, e.g. the plate 1 and the sleeves 2, can enable the joint to be used for elbows, shoulders, etc.

The material in all of the joint components, except for the socket, is titanium. The ball is suitably made of Titanium 6 AL 4Vm which is tempered and possibly ion-nitrated or otherwise surface-hardened. All of the other titanium components are made of titanium GRADE 1. The socket is made of polyethylene, and can be porous and impregnated with HEALON.

CLAIMS

1. Joint prosthesis, comprising a ball and a socket, surgically implantable anchoring means for the ball and socket, and connecting elements, by means of which the ball and socket can be fixed to their respective anchoring means, c h a r a c t e r i z e d in that the connecting elements (5, 12) comprise means (6, 8, 13, 18) permitting relative lateral displacement of the ball (19) and of the socket (10) relative to the associated connecting element, means (21, 22) for locking the ball and the socket onto the respective connecting element after adjustment of the ball and the socket in relation to each other, and means (14) arranged to permit vertical adjustment of the distance between at least one (2) of the anchoring means and the associated connecting element (12).

2. Joint prosthesis according to Claim 1, c h a r a c t e r i z e d in that the connecting elements (5, 12) have dovetail grooves (6, 13), and that the ball (19) and the socket (10) have slide portions (8, 18) fitting the grooves.

3. Joint prosthesis according to Claim 2, c h a r a c t e r i z e d in that the dovetail grooves (6, 13) are so oriented on their respective connecting elements (5, 12) that they extend essentially perpendicular to each other when the components are in their implanted state.

4. Joint prosthesis according to one of Claims 1-3, c h a r a c t e r i z e d in that the anchoring means (1, 2), the connecting elements (5, 12) and the ball (19) are made of titanium, and the socket (10) of polyethylene.

5. Joint prosthesis according to one of Claims 1-4 for an ankle, c h a r a c t e r i z e d in that one of the

anchoring means (1) is formed of a plate intended to be inserted into a vertical slot in the tibia and has a profiled edge portion (3) which, after the integration of the plate with the tibia, is intended to be inserted into a groove (4) in the associated connecting element (5), said profiled edge portion and the groove being disposed to permit a certain angular movement between the plate and the connecting element.

6. Joint prosthesis according to Claim 5, c h a r a c t e r i z e d in that the other anchoring means (2) is formed of a pair of internally threaded sleeves, intended to be implanted in the talus, that the associated connecting element (12) comprises links (14), which are intended to be screwed securely to the sleeves after the integration of the sleeves with the bone.

7. Joint prosthesis according to Claim 6, c h a r a c t e r i z e d in that the plate (1) and the sleeves (2) are perforated.

8. Joint prosthesis according to Claims 5 and 6, c h a r a c t e r i z e d in that the socket (10) and the ball (19) have guide members (8, 18) which, when the components have been implanted, are received in dovetail grooves (6, 13) in the respective connecting element (5, 12), which grooves are oriented essentially perpendicular to each other.

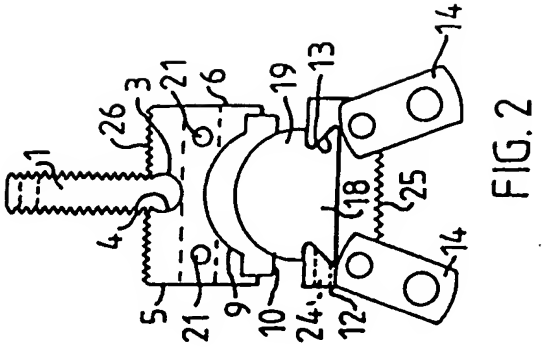
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FIG. 2

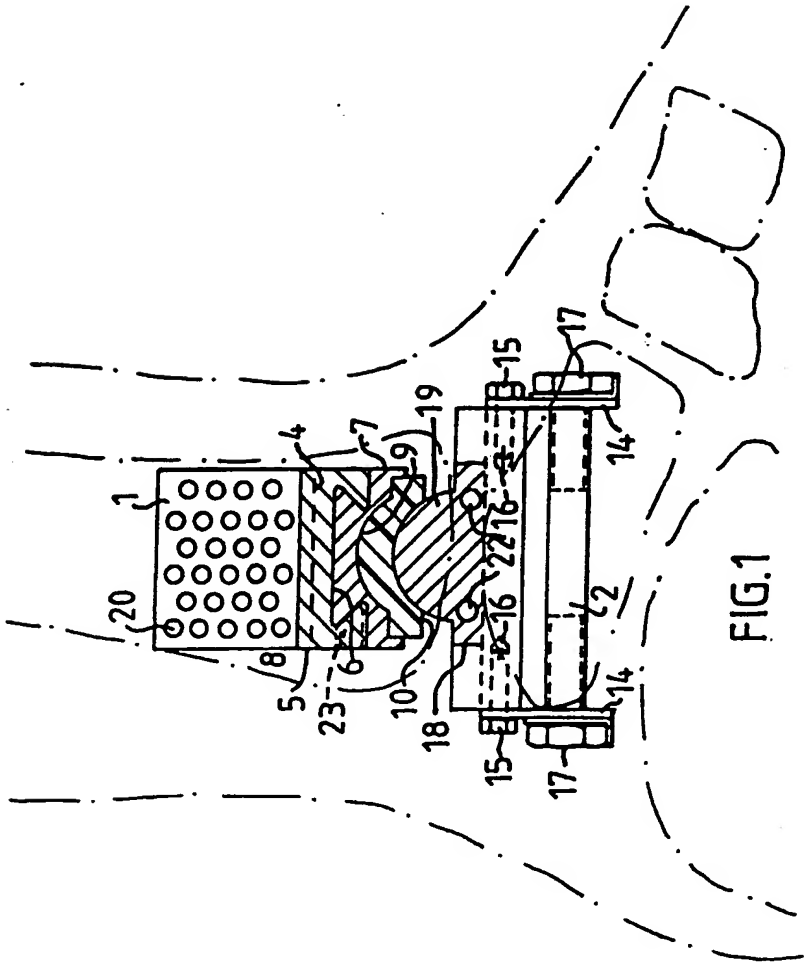
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FIG.1

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00791

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: A 61 F 2/30, 2/42

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	A 61 F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	SE, B, 313396 (VESSA LTD) 11 August 1969, see figure 6 --	1-3,8
A	GB, A, 2200555 (J.E. HANGER & COMPANY LIMITED) 10 August 1988, see the whole document --	1
A	US, A, 4038704 (RING) 2 August 1977, see the whole document --	4,5,7
A	US, A, 4673408 (GROBBELAAR) 16 June 1987, see the whole document --	1,2,4,8

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* Special categories of cited documents: [10]

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"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
19th February 1991	21.02.1991
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Leif Karnsäter

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00791

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 91-01-31 The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
SE-B- 313396	69-08-11	NONE		
GB-A- 2200555	88-08-10	EP-A-	0269391	88-06-01
		JP-A-	1136656	89-05-29
		US-A-	4883494	89-11-28
US-A- 4038704	77-08-02	DE-A-	2625744	76-12-23
		FR-A-B-	2313906	77-01-07
US-A- 4673408	87-06-16	EP-A-	0135319	85-03-27